SCANNING ELECTRON MICROSCOPY OF ULTRAVIOLET-REFLECTIVE PRUINOSITY IN SPECIES OF *OCHTHERA* (DIPTERA: EPHYDRIDAE)[1]

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ABSTRACT: The micro-structural characteristics of the ultraviolet-reflective pruinosity on *Ochthera* were studied with a Coates and Welter Model 106 field emission scanning electron microscope. Micrographs of pruinosity having the greatest ultraviolet reflectance on *Ochthera mantis* (De Geer) and *O. lauta* Wheeler showed it to be composed of flattened units somewhat concave in cross-section and abruptly deflected apically. Nonreflective or minimally reflective pruinosity in both species was shown to be composed of appressed subuliform units or, as on dark areas of the abdomen, short, decumbent, setuloid units.

The scanning electron microscopy of cuticular surfaces of acalyptrate Diptera has been largely neglected. Bauchhenss and Renner (1977) investigated the pulvillus of *Calliphora erythrocephala* (Diptera: Calliphoridae) and Slifer and Sekhon (1964) the fine structure of the sense organs on the antennal flagellum of *Sarcophaga argyrostoma* (Diptera: Sarcophagidae).

The present study was initiated to provide more information on pruinosity of acalyptrates and to determine the micro-structural characteristics of ultraviolet-reflective pruinosity on *Ochthera* (Diptera: Ephydridae). When photographed through a Wratten filter, the golden pruinose face and silvery pruinose front coxae of *O. mantis* were shown to reflect relatively much more ultraviolet radiation than other body regions (Deonier, 1975). These data along with observed semaphoring with the large raptorial front legs and experimental disruption of mating in sexual pairs by obliteration of reflective fore-coxal pruinosity were interpreted as evidence for a signalling function of the reflectance.

Materials and Methods

The 12 specimens of *Ochthera mantis* examined were collected at Ravenel L., Highlands, Macon Co., North Carolina; a tributary of Four-mile Cr., Preble Co., Ohio; and near Oxford, Butler Co., Ohio. The 4 specimens of *O. lauta* were collected in Kansas at Sappa L., Decatur Co. and the Kansas R. near

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Eudora, Douglas Co. and in Iowa near Fraser Dam on the Des Moines R., Boone Co. Both species were determined by using the keys and descriptions in Clausen (1977).

The specimens were mounted with double adhesive tape on standard aluminum studs and dried under incandescent light for 4 hours immediately prior to examination. The scanning electron microscope used was a Coates and Welter Model 106 field emission type having a maximum magnification of 90,000 X (photographic) or 180,000 X (visual) and a resolution of 60Å. Micrographs were made on Kodak 120 film (ASA 400) at f:5.6 with an emission current of 18 amperes and an accelerating voltage of 50. Ultraviolet reflectance was photographed on Kodak Tri-X Pan (ASA 400) at f:8, 0.8 sec. through a Kodak Wratten Ultraviolet Filter No. 18A (filter window range 3,000-4,000 Å) fitted to a 55 mm F:3.5 Micro Nikkor Auto lens on a Nikkormat camera.

Results

Scanning electron micrographs of pruinosity on adults of *Ochthera mantis* and *O. lauta* having the greatest reflectance of ultraviolet radiation showed it to be composed of flattened units somewhat concave in cross-section and abruptly deflected apically. The face of *O. mantis* (Fig. 1) is golden pruinose with paired ventrally diverging paramedial ridges. At low magnification, the pruinosity had a beaded-mat texture (Fig. 3) which at higher magnification was resolved into dense, apically deflected semierect lanceolate units (Fig. 4). This deflection of the apices (Fig. 7) occurred so regularly in all specimens that it was not likely an artifact. These broad, thin units (Fig. 6) had slightly upturned edges and averaged 0.40 um wide (range 0.35-0.48) and 1.90 um long (range 1.10-3.26). They occurred on both the median and lateral areas of the face and were sharply demarcated from units of the parafacialia, which were typically long, ensiform units (Fig. 4, 5) averaging 0.30 um wide (range 0.20-0.37) and 2.70 um long (range 2.25-2.49). The pruinosity units of face and parafacialia differed markedly in specific density and orientation. The long axes of the facial units were oriented dorsoventrally whereas those of the parafacial units were variably oriented (Fig. 3, 4, 5). The specific densities of the facial and parafacial units averaged respectively 100 per 100 um^2 (range 89-108) and 200 per 100 um^2 (range 180-212).

The face of *O. lauta* (Fig. 2) is moderately gibbose centrally with a pair of median silvery or golden-pruinose stripes separated by a slightly rugulose, shining black stripe and bordered laterally by paired, diagonally rugulose, ventrally diverging, shining black lines. Lateral to these lines are 7-9 shining black, shallow transverse depressions surrounded by silvery or golden pruinosity so as to give a definite barred impression to the face. The

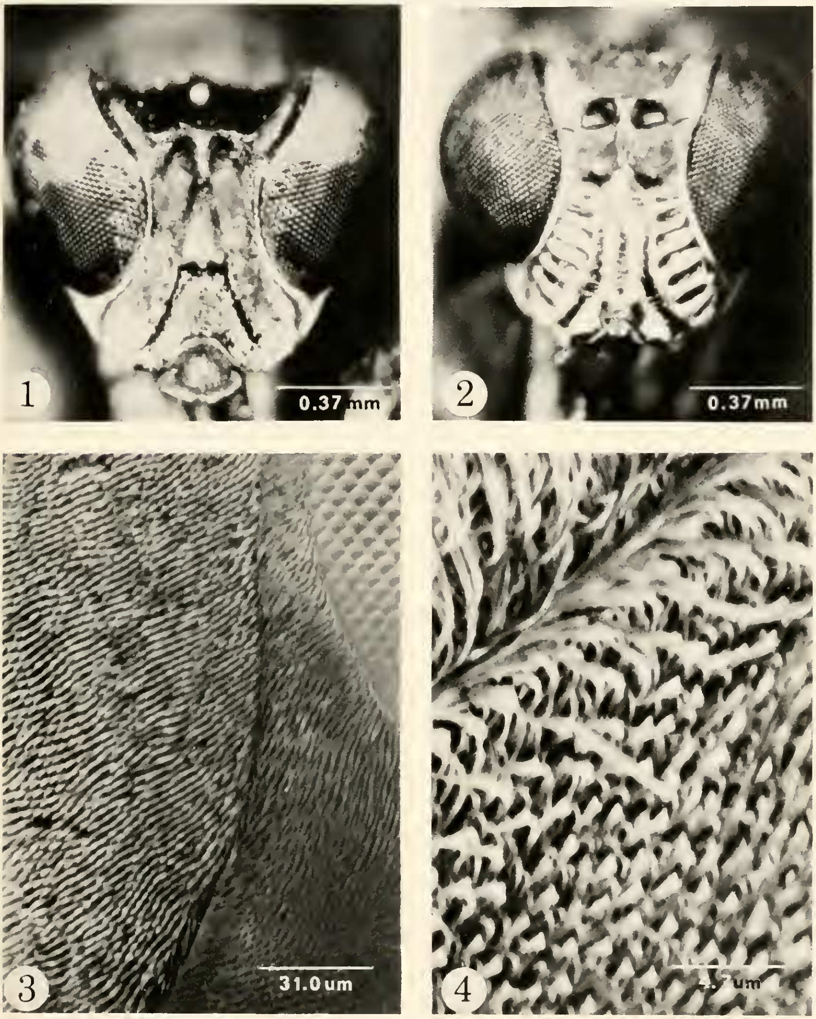

Fig. 1. *O. mantis*: head, anterior view. Fig. 2. *O. lauta*: head, anterior view. Fig. 3. *O. mantis*: head, suture between face and parafaciale, anterior view. Fig. 4. *O. mantis*: head, suture between face (lower) and parafaciale (upper), anterolateral view.

transverse depressions (Fig. 9, 10) are bare except for the paired inner and outer facial setae. The pruinosity surrounding the depressions consisted of flattened, decumbent arcuate units (Fig. 10, 11). These units which also occur on the parafacialia and genae averaged 1.60 um wide (range 1.11-2.20) and 23.10 um long (range 14.00-28.40). They were directed medioventrad (Fig. 9, 10) and averaged 6 per 100 um^2 with a range of 4.79-7.10 per 100 um^2 (Fig. 10, 11).

Examination of the anterior coxal surfaces of *O. mantis* (Fig. 13) showed that the highly reflective silvery pruinosity consisted of both semierect, broad, thin lanceolate units (Fig. 8) and numerous semierect, striated, linear-lanceolate units (Fig. 14). The lanceolate units were slightly narrower and less attenuated apically than those on the face. Also, the entire unit tended to be gradually decumbent (Fig. 8) as opposed to the abrupt deflection of the apex in the facial unit. Density differences between anterior and lateral coxal surfaces were not sharply delineated. In *O. lauta,* anterior coxal surfaces were covered primarily with semierect flattened, linear-lanceolate units having projecting, non-deflected apices. The only sharp demarcation in density was associated with the proximal end of the anterior coxal surface (Fig. 12). Measurement of units in these zones showed noticeable size differences. The linear-lanceolate units in the sparse zone averaged 1.40 um wide (range 0.73-1.44) and 13.10 um long (range 9.10-17.30) as compared to the appressed setuloid units of the dense zone which averaged 0.70 um wide (range 0.45-0.73) and 15.40 um long (range 10.00-16.50). The average specific density of the dense zone was about twice that of the sparse zone.

The pleura of both species had reflective pruinosity of the semierect linear-lanceolate type with abruptly deflected apices. This pleural pruinosity was noticeably denser in *O. lauta.*

Nonreflective surfaces of both species had appressed subuliform units (Fig. 15) or, as on dark areas of the abdomen, short, decumbent, setuloid units (Fig. 16). The latter averaged 0.60 um in diameter (range 0.12-1.10) and 17.50 um in length (range 12.50-26.10). The femora had comparable nonreflective units as did the lateral (outer) surfaces of the fore-coxae where they were arranged in clusters of 3 within rows (Fig. 15).

Discussion

The results indicate that the pruinosity with maximal ultraviolet reflectance is composed of flattened units with slightly upturned edges whereas pruinosity with minimal ultraviolet reflectance is composed of round units. Apparently, the abruptly deflected apices in combination with the broad,

Fig. 5. *O. mantis*: head, lanceolate facial pruinosity (left) and linear-lanceolate parafacial pruinosity (right), anterolateral view. Fig. 6. *O. mantis*: head, lanceolate facial pruinosity, anterior view. Fig. 7. *O. mantis*: head, lanceolate facial pruinosity showing apical deflection, lateral view. Fig. 8. *O. mantis*: front coxa, anterior surface, anterolateral view.

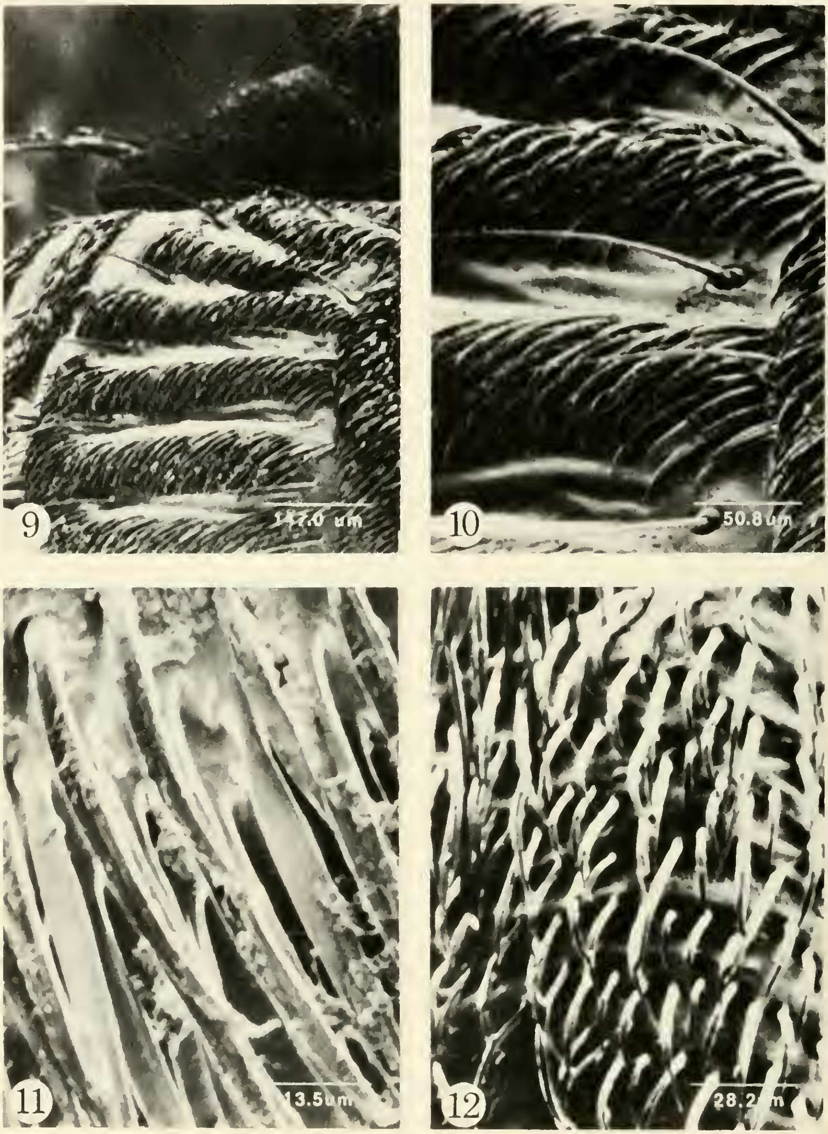

Fig. 9. *O. lauta*: head, transverse facial depressions, anterolateral view. Fig. 10. *O. lauta*: head, transverse facial depressions, anterolateral view. Fig. 11. *O. lauta*: head, facial pruinosity around transverse depression, anterior view. Fig. 12. *O. lauta*: front coxa, anterobasal surface, anterior view.

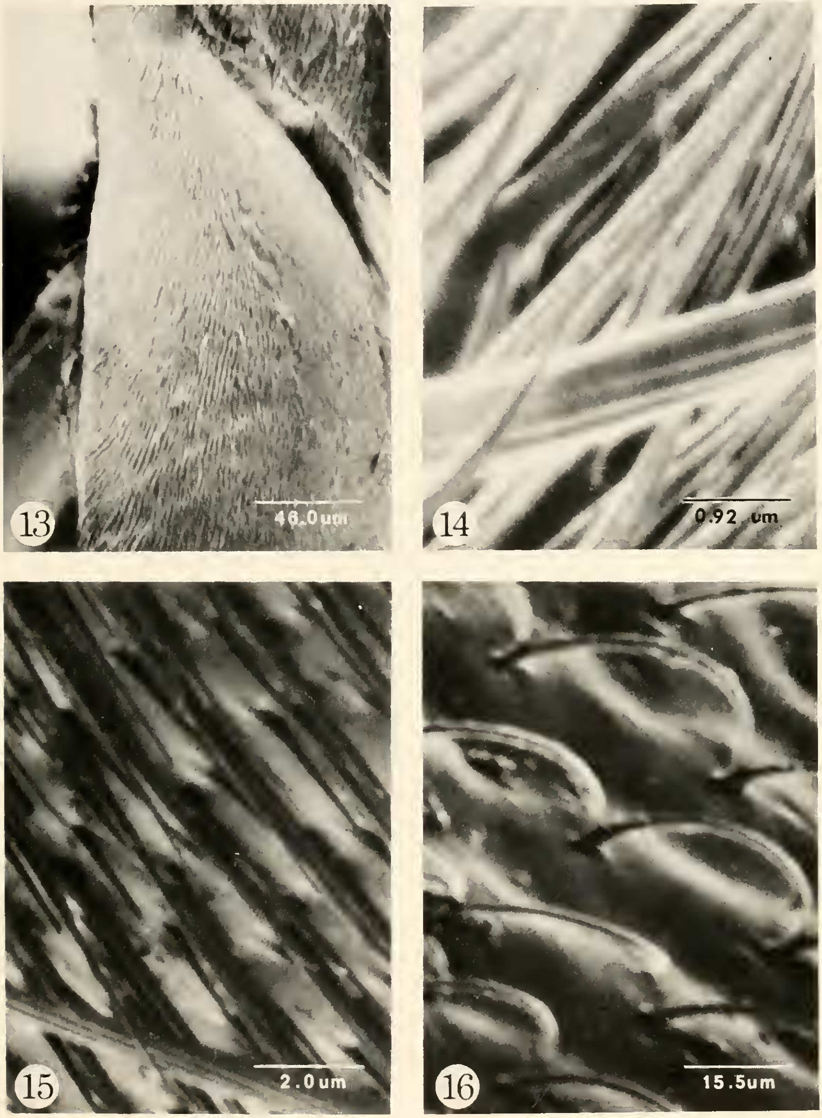

Fig. 13. *O. mantis*: front coxa, anterior surface, anterior view. Fig. 14. *O. mantis*: front coxa, anterior surface pruinosity, anterolateral view. Fig. 15. *O. mantis*: front coxa, lateral surface, anterolateral view. Fig. 16. *O. lauta*: abdomen, dorsum, dorsolateral view.

slightly parabolic exposed shafts of the units effect the maximum reflectance possible from hairlike pruinosity units. The analogy to certain highly reflective lepidopteran scales is reinforced by the greater specific density of highly reflective pruinosity compared to dark or minimally reflective pruinosity.

All of the nonsocketed units of both types of pruinosity appear to be identical to microcuticular processes in Trichoptera to which Slifer and Sekhon (1971) applied the term microtrichia. However, we wish to point out that the term microtrichia (singular: microtrichion) has been defined as minute, nonsocketed, hairlike processes on the membrane of wings, e.g. in Diptera, Mecoptera, and Trichoptera (Chapman, 1971; Imms, 1957; Torre-Bueno, 1937; and others). A precise morphological term is needed for these pruinosity units and other nonsocketed microcuticular processes and, if the term microtrichia cannot, without confusion, be extended to include them, we propose that the term nanotrichia be used for them.

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